Eyewitness News: How Science Can Help You Understand and Reduce Bias in Eyewitness Testimony

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Introduction

Memories often serve us well; for example, independent observers corroborate one another's accounts, the physical evidence obtained from a scene coincides with details that an eyewitness recalls, and eyewitnesses report experiences, sequences of events, or behaviors that are consistent with their capabilities and limitations. Accordingly, in many situations, scientists rely on eyewitness memories as they develop their understanding of an event and evaluate potential causes and contributors. However, decades of scientific research demonstrate that it would be a mistake to assume categorically—as laypersons often do[1]—that recalling an event from memory is the equivalent of replaying a video of the event as it actually happened. The human brain is not equipped with such a videorecorder. In some situations, memories of events can be fallible and subject to bias. Environmental, contextual, and individual factors interact to influence whether and how we encode events into memory, what parts of a memory we retain in storage over time, and whether and how we later recall the event. Understanding the scientific basis of memory formation, storage, and retrieval assists in understanding how memories can sometimes fail to coincide with experienced events. In turn, this understanding assists in the evaluation of the scientific reliability of eyewitness testimony.

The Basics of Memory Science

Memory scientists have established that memory is not a unitary construct. There are multiple types of memory and there can be multiple stages within each type. For example, when an observer experiences an event, these perceptions may be retained in short-term *Sensory Memory* that lasts mere seconds. Such "iconic" or "echoic" memories are briefly replayed in the mind for an observer and may be quickly lost. This occurs when someone quickly looks at a phone book and then looks away but can recall the exact image of the phone number while attempting to dial. Observers who pay attention to specific perceptual stimuli or events continue to retain that information in *Short-Term Memory* or *Working Memory*.[2] Short-Term Memory refers to the subset of recently learned or experienced information that an observer retains for an intermediate period of time (i.e., more than several seconds but not necessarily long-term) and may or may not remember later.[3] Short-term Memory is limited both in terms of the length of time information is available and the amount of information that one can recall.[4] Working Memory is a system that holds both recently learned information from Short-Term Memory and information recently retrieved from Long-Term Memory. Working Memory holds these different sources for the purposes of complex mental tasks—such as retaining partial results when solving an arithmetic problem, avoiding adding the same ingredient twice when baking,

[1] Simons & Chabris, 2012; Schacter, 1995
[2] Cowan, 2008
[3] Cowan, 2008
[4] Cowan, 2008

and retaining an idea and combining it with additional ideas when planning or reasoning.

Regardless of whether we retain information temporarily in Short-Term or Working Memory, our ability to remember this information days later depends on whether we have consolidated it into *Long-Term Memory*. Long-Term Memory is the type of memory that allows individuals to recall their high school prom and to know the capital of France. Asking an eyewitness to recount details of events experienced in the past is, most typically, a probing of that witness's Long-Term Memory. Long-term Memory comprises three stages:

(1) *Encoding*: The process of getting information into Long-Term Memory;

(2) *Storage*: The maintenance of information in Long-Term Memory; and

(3) *Retrieval*: The act of accessing information stored in Long-Term Memory (which may include integration into online Working Memory).

Long-term Memory is essentially limitless in capacity, although it is not flawless.[5] When an event is encoded into memory, the event is not encoded as a whole. Rather, we encode events as fragments.[6] For example, we do not encode an entire wedding as a single, detailed unit. Rather, we encode it as a series of small details, such as a snippet of a conversation with a wedding guests, a particular song noticed, or the taste of the wedding cake. Critically, we integrate these fragments with related fragments from other sources, such as prior expectations, causal inferences, and facts learned after the event. This reconstruction can occur during encoding.[7] For example, you can incorporate the present interaction between you and your cousin with fragments related to past interactions with that same cousin, you can compare and contrast the taste of the wedding cake with memories of other cakes, and so on. Reconstruction can also occur during storage or re-storage.[8] For example, the day after the wedding, you may remember that the cake was chocolate with a buttercream frosting, while several months later you may simply remember that it was tasty. Reconstruction can also occur during retrieval, such as when you later attempt to recount that same wedding to a relative who missed it.[9] Now, the memory may include not only the original experience, but also related experiences such as the wedding cake at your brother's wedding or the reasons you inferred for why your mother didn't wear her corsage. Furthermore, during the act of recounting that memory, you may learn new information—such as a song that your relative mentioned during your conversation—that you then encode and store as another fragment related to that event. Thus, the cycle of introduction and reconstruction of fragments continues.[10]

As discussed previously, the reconstructive process maintains sufficient accuracy to serve us well, both day-to-day and in many situations where others (such as expert witnesses) must rely upon an individual's recollection. However, the opportunity for error—during encoding, during, storage, and during retrieval—is clear. Below, we discuss potential sources of error, and

[5] Eysenck & Keane, 2015
[6] Schacter, 1995
[7] Lacy & Stark, 2013
[8] e.g., Lacy & Stark, 2013
[9] Lacy & Stark, 2013
[10] Lacy & Stark, 2013

their potential consequences, during these three stages.

Potential Sources of Error during Memory Encoding

Errors that occur at the encoding stage—i.e., when we experience the event and consolidate it into Long-Term Memory—are critical in that they can persist through the storage and retrieval stages. A primary source of error at encoding is the quality of the information received through the senses (e.g., seeing, hearing, touching) during the experienced event. In other words, a person can only encode what they believe they saw, heard, or felt—regardless of whether those observations align with reality. Common sources of perceptual distortions and limitations include weather and astronomical conditions (e.g., moonlight), the level, quality, and distribution of artificial lighting, partial or full obstructions to lines of sight, the distance between the observer and a detail of interest, and the loudness and/or similarity of ambient noise relative to a noise of interest.[11] For example, research shows that, under certain circumstances, pedestrians can misjudge the locations of backup alarms[12] and observers can misperceive the distances between objects.[13] In candidate sets of circumstances, studies have documented maximum distances and minimum illumination levels under which an observer can reliably recognize faces, facial expressions, and objects or certain sizes or colors.[14] Thus, knowledge of the environmental factors contemporaneous to a witness's observations allows for a scientific assessment of the likely accuracy of those observations.

In addition to their environmental surroundings, both the personal state and task of an observer can influence the quality and degree of information that he or she encodes. For example, studies have shown that participants who experience a stressful event—such as getting shots[15] or being interrogated with physical confrontation[16]—are less able to identify the individuals they interacted with during the stressful event than individuals they interacted with before or after. A striking consequence of stress is perceptual narrowing, wherein individuals become increasingly selective about the information they process and retain. Researchers have pointed to a role of perceptual narrowing in such phenomena as "weapon focus"[17]—where eyewitnesses show a reduced ability to describe a gunman owing to increased time spent looking at the gun—and the inability to recall a smoke alarm that sounded during a fire.[18] The in-the-moment task, or goal, of an observer can influence what he or she attends to—and what he or she does not—to a similarly striking degree. For example, drivers looking for one type of sign[19] and pedestrians who expect to encounter obstacles at a particular location[20] are more likely than their untasked counterparts to notice what they are looking for—and to miss what they are not. This general effect, referred to as inattentional blindness, persists even when the task-irrelevant stimuli are highly salient—such as a fire extinguisher located next to one's office door[21] or a

[11] e.g., Krauss, 2015
[12] Heckman et al., 2011; Casali et al., 2002
[13] Loomis et al., 1996
[14] De Jong et al., 2005; Loftus & Harley, 2005; Smith & Schyns, 2008
[15] Peters, 1988
[16] Morgan et al., 2004
[17] Loftus et al., 1987
[18] Motta-Mena et al., 2020
[19] Cole & Hughes, 1984
[20] Patla, 1997
[21] Castel et al., 2012

unicycling clown in a university square.[22] A failure to attend to an event is a failure to perceive and process it, which, in turn, results in a failure to encode the information (i.e., inattentional amnesia). Thus, knowledge of the observer's mental state and in-the-moment task also allows for a scientific assessment of the observations he or she does—or doesn't—report.

Potential Sources of Error during Memory Storage

Those fragments of a witnessed event that are encoded into memory must then remain preserved in Long-Term Memory until recalled at a later time. Yet, during this time, these fragments--and the connections among them--may decay and lose perfect preservation. The most obvious effect of such decay is forgetting.[23] However, researchers have discovered another interesting implication of decay. In one study, researchers asked participants to read a story and then, later, to fill in missing words from the same prose.[24] When only ten minutes had elapsed, participants were able to fill in the exact missing words (e.g., "jeans" or "poodle"). When a week had passed, participants were more likely to fill in the gist of the missing words (e.g., "pants" or "dog"). Thus, when details begin to fade, observers may be left with a higher-level representation—or "gist"—of what happened.[25] Furthermore, stored memories are also prone to errors as a result of experiences and information encountered subsequent to their encoding and prior to a retrieval of interest. In a striking example of these effects, researchers in one study tested memory recall by pairs of research subjects who watched different videos of a crime, each of which contained some items that were not present in the other video.[26] Critically, researchers allowed some pairs to discuss the event with their co-witness prior to administering a recall test. Seventy-one percent of participants in these pairs mistakenly recalled items that were not present in their own video. They could only have acquired these items during discussion. Furthermore, one participant in each pair did not actually see conclusive evidence of a crime occurring (i.e., they could not see the individual taking an item from the room). However, after discussing it with their co-witness, 60% of these participants stated that the person shown in the video was guilty.[27] Such findings suggest that evaluation of eyewitness testimony benefits from knowledge of storage-related factors, such as the duration of time since the event occurred and what discussions the eyewitness may have had with others since then.

Potential Sources of Error during Memory Retrieval

Memory retrieval occurs when we reconstruct a stored memory for the purposes of remembering or retelling an event. In addition to errors that can occur at the time we experience, encode, and store the event in memory, the circumstances under which we access and piece together the fragments present further opportunities to shape memories and incorporate new information we may not have personally witnessed. For example, in one of the original examinations of memory distortion, researchers found that the wording that an interviewer uses to question a witness changes what the witness recalls. Witnesses to a simulated car accident were asked slightly different versions of the same question, such that some questions suggested

[22] Hyman et al., 2010
[23] Eysenck & Keane, 2015
[24] Pansky & Tenenboim, 2011; Panksy & Koriat, 2004
[25] Schacter et al., 2011
[26] Gabbert et al., 2003
[27] Gabbert et al., 2003

faster speeds than others—e.g., "About how fast were the cars going when they contacted each other?" compared to "…smashed into each other?" Witnesses presented with the word "smashed" estimated a higher speed than witnesses presented with the word "contacted," even though all witnesses had observed the same event.[28] Research also shows that distortions need not arise from external sources. For example, people observing an event, particularly one that is ambiguous or uncertain in some way, may reason or infer what caused the event. In an examination of the effects of such causal inferences, researchers showed that some participants who witnessed the effect of some event (e.g., oranges spilled on the floor of a produce section) falsely recalled that they also saw the cause of the event (e.g., a person pulling an orange from the bottom of the bin). In fact, the witnesses never saw the causal event.[29] Similarly, studies demonstrate that eyewitnesses can sometimes imagine details to explain new information and subsequently incorporate these details into memory.[30] In one such study, experimenters asked participants about several autobiographical events from the participant's childhood, as described by the participant's family members.[31] Unbeknownst to participants, one of these events did not actually occur (e.g., knocking a punchbowl into the bride at a wedding). Some participants began to "recall" details about the event when questioned about it repeatedly across several days--sometimes adding substantial detail such as the location, others involved, and what happened before and afterward. Yet, other results from the same study suggest that repeated questioning also aided recall of accurate details for actual events. Such research illustrates the complexities of the circumstances and context in which a witness retrieves, retells, and answers questions about their memories.

Conclusion

The present overview has touched upon a small sample of studies from a wide body of scientific literature demonstrating the counter-intuitive proposition that, although our memory generally serves us well, one cannot assume that memories are infallible. This research allows one to apply the scientific method by testing predictions regarding the likelihood of error given such factual evidence as: the mental state of a particular witness; the conditions under which the witness observed the event; intervening events that occurred; and the circumstances in which the witness has recounted the event. Such evaluations, when conducted in accordance with both the science and the facts of an incident, can provide valuable insight as to the general scientific reliability of eyewitness testimony. They can further identify empirically-established reasons why one witness's account may not correspond with other witness accounts, physical evidence, or scientific findings. This research also suggests potential techniques for reducing bias in eyewitness testimony—such as the use of open-ended, non-leading questions and the isolation of eyewitnesses from one another prior to taking statements. In summary, eyewitness memory can be a valuable source of information about a given event but requires careful and reasoned consideration of human capabilities and limitations for investigators to realize its value.

[28] Loftus & Palmer, 1974
[29] Hannigan & Reinitz, 2001
[30] Halberstadt & Niedenthal, 2001; Hyman et al., 1995
[31] Hyman et al., 1995